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ABSTRACT

This study examined the effect of presentation rate on accuracy of digit serial recall and on serial position curves of digit strings of different lengths with 18 boys classified as reading retarded and a comparison group of children (ages for both groups averaged 11 years) who read at grade level. The results indicated that normal children recalled significantly more digit strings than did the reading retarded children, but that the effect of rate was different for the two groups of children. The average number of strings correctly recalled increased linearly with an increase in rate for the reading retarded group, but the normal group did best at both the fast and the slow rates. An examination of the serial position curves for both groups revealed that while the curves of the normal children maintained the primacy effect across the different rates of presentation, the curves of the reading retarded children showed a lack of a primacy effect at slow rates and an increase in the primacy effect at the fast rate. (Author/PHR)

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The Effect of Rate of Presentation on Digit Serial Recall in Reading Retarded Children

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Previous research has indicated that children classified as reading retarded usually test at the normal level of intelligence, however, they perform poorly on the Digit Span subtest of the Wechsler Intelligence Scale for Children - Revised (WISC-R), when compared to the performance of children who read at grade level (Huelsman, 1970; Klasen, 1972). In addition, performance on the Digit Span accounts for a large portion of variance of reading ability in reading retarded children (Spring, 1970). We hypothesized that poor performance might be due to a deficient verbal rehearsal strategy; these children might be relying on a more passive acoustical strategy which decreases accuracy on the task.

In general, the WISC Digit Span has been considered a measure of short term memory (STM), with increases in accuracy attributed to cognitive strategies, such as rehearsal or encoding. Based on a dual-storage model of memory, investigators have suggested that as children mature they become more efficient and spontaneous in using rehearsal strategies, which, in turn, facilitate transfer of information from STM to long term memory, thereby increasing recall (Belmont & Butterfield, 1969). It is further hypothesized that it is this use of a mediational strategy which obtains the commonly reported U-shaped curves in the serial recall paradigm, with the primacy effect greater than the recency effect (Frank & Rabinovitch, 1974).

It has been demonstrated, however, that both the primacy effect and success in recall can occur at fast presentation rates (Frankel & Tymchuk, 1974; Sarver, Howland & McManus, 1976). These findings become difficult to explain by the dual-storage rehearsal hypothesis because, given the fast rate of presentation, input of stimuli precludes rehearsal. Thus, it has been suggested that rate of presentation interacts with different input-processing strategies which thereby influence recall.

For instance, Hockey (1973) found that using an active rehearsal strategy with fast presentations decreased recall, but when subjects were instructed to use a passive strategy with fast rates, recall increased. Aaronson (1974) presented evidence for a sensory strategy at fast rates and a verbal identification strategy at slow rates. These strategies determined different serial position curves, which even persisted over time when stimulus parameters changed. With children, Sarver et al. (1976) reported an age-related primacy effect with fast rate which could be not explained by the use of an age-related improvement in mediational strategies. They hypothesized that rapidly presented stimuli are processed acoustically by the right hemisphere, while slowly presented stimuli are processed semantically by the left hemisphere -- both dependent on central nervous system maturation.

In light of the above evidence, successful recall on a digit span test might be influenced by the input processing strategy used by the child. If the child uses verbal identification and rehearsal, he probably does well at slow rates of presentation. If he relies on sensory representation, he might do better at fast rates. If the child has both processing strategies available, he may be able to successfully switch strategies, when rates of input of information change.

Our investigation examined the effect of three rates of presentation on accuracy of digit span recall and on the serial position curves of reading retarded children and of children who read at grade level. We hypothesized that 1) normal children would do well at all three rates, 2) reading retarded children would demonstrate an increase in accuracy with an increase in rate, and 3) the above findings, plus an examination of serial position curves by presentation rate might suggest different

input processing strategies for the two groups.

METHODS

Subjects: The reading retarded sample was chosen from the Fernald School for learning disordered children at the University of California, Los Angeles. The group consisting of "normal children," i.e. children who read at grade level, were chosen from the University Elementary School on the same campus. Each group consisted of 18 boys each. The reading retarded group had a mean age of 10.86 years; the normal grade had a mean age of 10.87 years. All reading retarded children read one year below grade level.

Digit Span Test: Three different digit sets were compiled, each set having 14 different digit strings. The 14 strings included seven different lengths (3 to 9 digits), with two strings at each length. Same length strings were presented consecutively, but length was random within sets. Presentation rates of digits were one digit per three seconds (1/3 sec), one digit per second (1/sec), and four digits per second (4/sec). The different sets of digits at different presentation rates were recorded on a tape cassette. Each digit string was followed by a tone (600Hz) which signaled the end of the string and informed the subject to respond.

Design: The criterion for correct recall was repeating a string of digits in correct serial recall. Data were analyzed using a 2 (Group) x 3 (Rate) x 18 (Subject) mixed analysis of variance design with repeated measures in the second factor. Serial position curves at each presentation rate were determined by converting error data into probability of correct recall.

RESULTS

Longest string recalled. The two groups of children differed significantly on average length of string recalled in correct serial order. $F(1,34) = 12.28$, $p<.01$. Collapsing over presentation rate, the normal children recalled a longer string (mean=6.4) than the reading retarded children (mean=4.9). Figure 1 demonstrates that recall increased with rate for both groups: $F(2,68) = 12.32$, $p<.001$.

Number of strings recalled. The two groups of children differed significantly on number of strings recalled in correct serial order. $F(1,34) = 20.6$, $p<.001$. Collapsed over presentation rate, the normal children recalled more strings (mean=22.8) than the reading retarded children (mean=13.9). As Figure 2 depicts, recall changed as a function of rate for both groups, but the effect of rate was different for the groups. ($F(2,68) = 6.7$, $p<.01$.) A trend analysis revealed that the average number of strings recalled increased linearly with an increase in rate for the reading retarded children, $F(1,34)=47.75$, $p<.001$, but the data for the normal children showed both significant linear ($F(1,34)=4.23$, $p<.05$) and quadratic components ($F(1,34)=7.66$, $p<.01$), indicating an increase in recall with both fast and slow rates, in comparison to recall at the medium rate.

Serial position curves. An examination of the five digit string length by rate in Fig. 3 demonstrates that rate does not seem to affect the SP curves of the normal children, but a decrease in rate seems to steadily decrease the primacy effect for the reading retarded children.

DISCUSSION

The results indicate that normal children recall longer and more strings of digits in correct serial order than childen classified as reading retarded. However, the reading retarded group shows a linear increase in number of strings correctly recalled with an increase in rate, while the normal group shows better recall at both fast and slow rates.

These findings, if interpreted according to the theoretical analyses of other investigators, suggest that the success of correct recall by both groups at the fast rate might be due to the adoption of a passive sensory strategy (Aaronson, 1974; Hockey, 1973; Neisser, 1967). The normal group, however, may be able to switch from this passive strategy to an active verbal identification-rehearsal strategy when the rate becomes slow; thus, they are also successful at recall at slow rates. The reading retarded group, however, may be maintaining a habitual passive mode of processing the incoming information which may not be effective at slow rates. Hockey (1973) showed that an active rehearsal strategy improved recall at slow rates (1/sec) and deteriorated recall at fast rates (3/sec), while a passive strategy showed the opposite trend, improving recall with an increase in rate. These findings demonstrate an interaction between rate and input processing strategy.

An examination of the serial position curves for the 5 digit string by rate may further support our hypothesis that normal children are more proficient at switching strategies, while the reading retarded children maintain an information processing mode which is ineffective at slow rates. The serial position curves of normal children maintain

the primacy effect at all rates; the reading retarded children show the primacy effect only at fast rates; the effect is depressed at slow rates. Sarver et al. (1976) found a primacy effect for digit recall at both fast and slow rates with normal fifth grade children - the finding was age related. They suggest that older children have more effective mediational strategies (slow rate) and improved acoustical information processing (fast rate), both based on CNS maturation, respectively of the left and of the right hemisphere.

It has been demonstrated that the time period between grades 3 and 5 is critical for the adoption of a mature rehearsal pattern (Frank & Rabinovitch, 1974). If reading retarded children do not spontaneously adopt rehearsal strategies at these early ages, it may become important to determine if they can be instructed to switch strategies and to use a mediational rehearsal approach at slow rates of presentation of material, thus possibly benefiting their memory recall.

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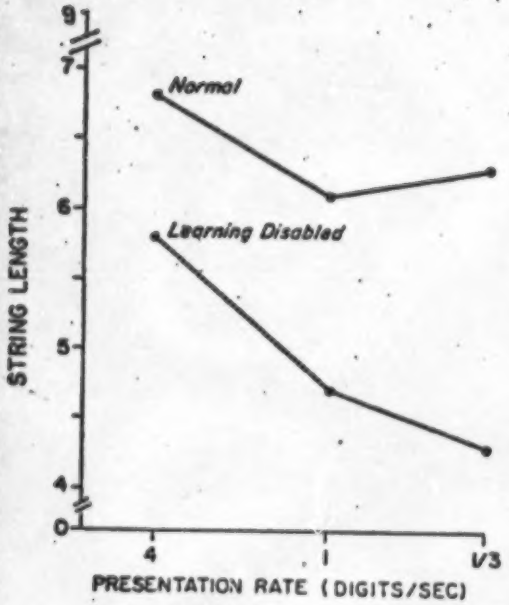

Fig. 1. Longest string recalled as a function of presentation rate for normal and learning disabled groups.

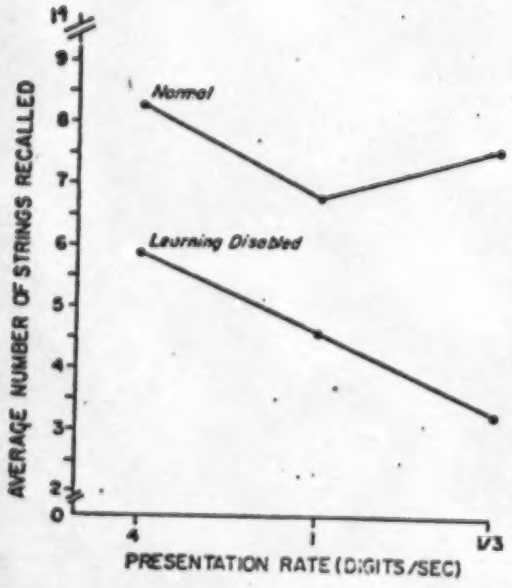

Fig. 2. Average number of strings recalled as a function of presentation rate for normal and learning disabled groups.

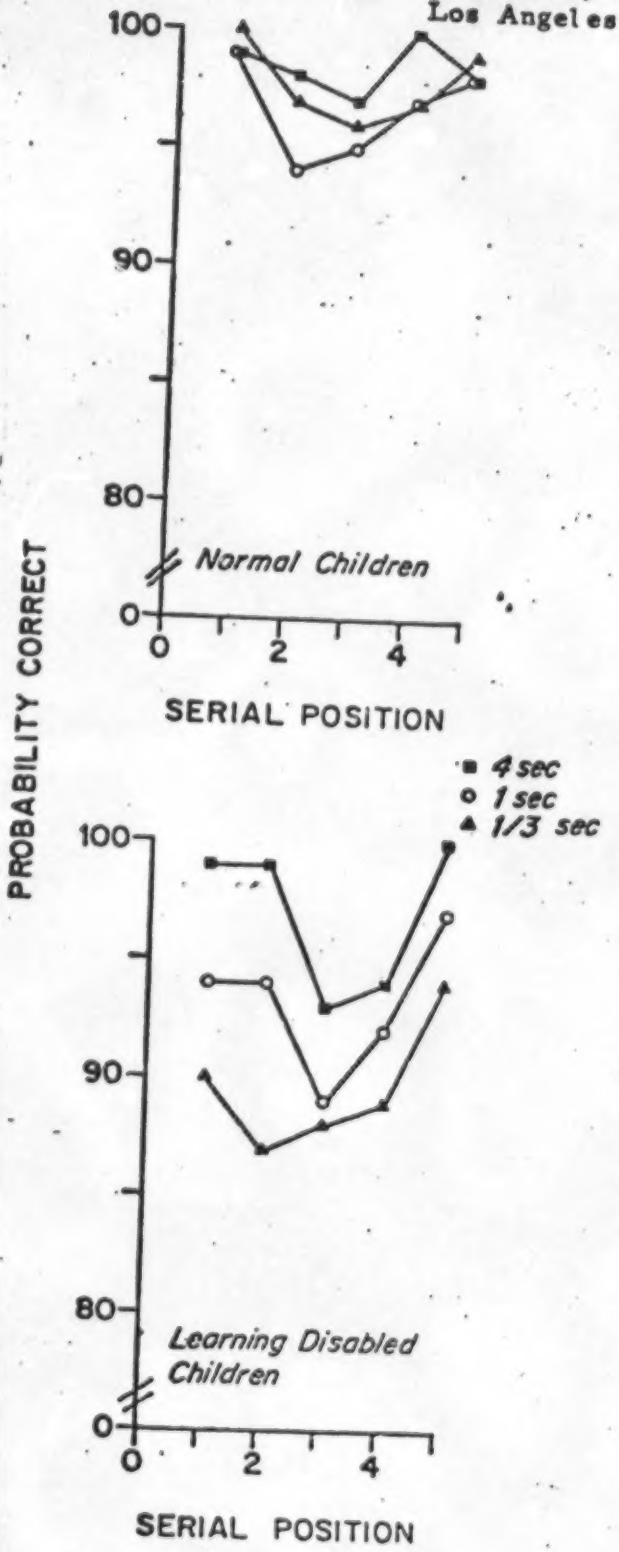

Fig. 3